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FLOOD INSURANCE STUDY

CITY OF WAUKEGAN, ILLINOIS

LAKE COUNTY

best copy available

DECEMBER 15, 1980

federal emergency management agency
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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

CITY OF WAUKEGAN,
LAKE COUNTY, ILLINOIS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Waukegan, Lake County, Illinois, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Waukegan to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Harza Engineering Company, for the Federal Insurance Administration under Contract No. H-4562. This study was completed in May 1979.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of Harza Engineering Company (Harza), the FIA, and the City of Waukegan in July 1977. Results of the hydrologic analyses were coordinated with the Illinois State Water Survey (SWS), the Illinois Department of Transportation, Division of Water Resources (DWR); and the U.S. Department of Agriculture, Soil Conservation Service (SCS). Hydraulic analyses were coordinated with the DWR and the SCS. During the course of the work by the Study Contractor, flood elevations, flood boundaries, and floodway delineations were reviewed with community officials, the FIA, and the DWR.

On June 5, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the FIA, the City of Waukegan, and the Study Contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Waukegan, Lake County, Illinois. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the City of Waukegan.

The flooding sources studied by detailed methods are listed below:

a. the Des Plaines River, extending from the southern border of Waukegan to a point about 4,000 feet upstream;

b. Suburban Country Club Tributary, extending from a point 4,960 feet upstream of its confluence with the Des Plaines River to downstream of the Chicago and North Western railroad;

c. Bull Creek, extending from the Chicago and North Western railroad to Lewis Avenue;

d. Wilson Avenue Tributary of Bull Creek, extending from its confluence with Bull Creek to Wilson Avenue;

e. North Shore Ditch, extending north through the city from the underground conduit near Jack Benny Junior High School at Montesano Avenue to a point approximately 500 feet downstream of Butrick Street;

f. the Waukegan River, from Glen Flora Avenue to Sunset Avenue; and

g. Lake Michigan, shoreline from 10th Street to the southern boundary of the Illinois Beach State Park.

The reach of Wilson Avenue Tributary that was studied in detail was dropped from the finished study because its flooding was entirely beyond the

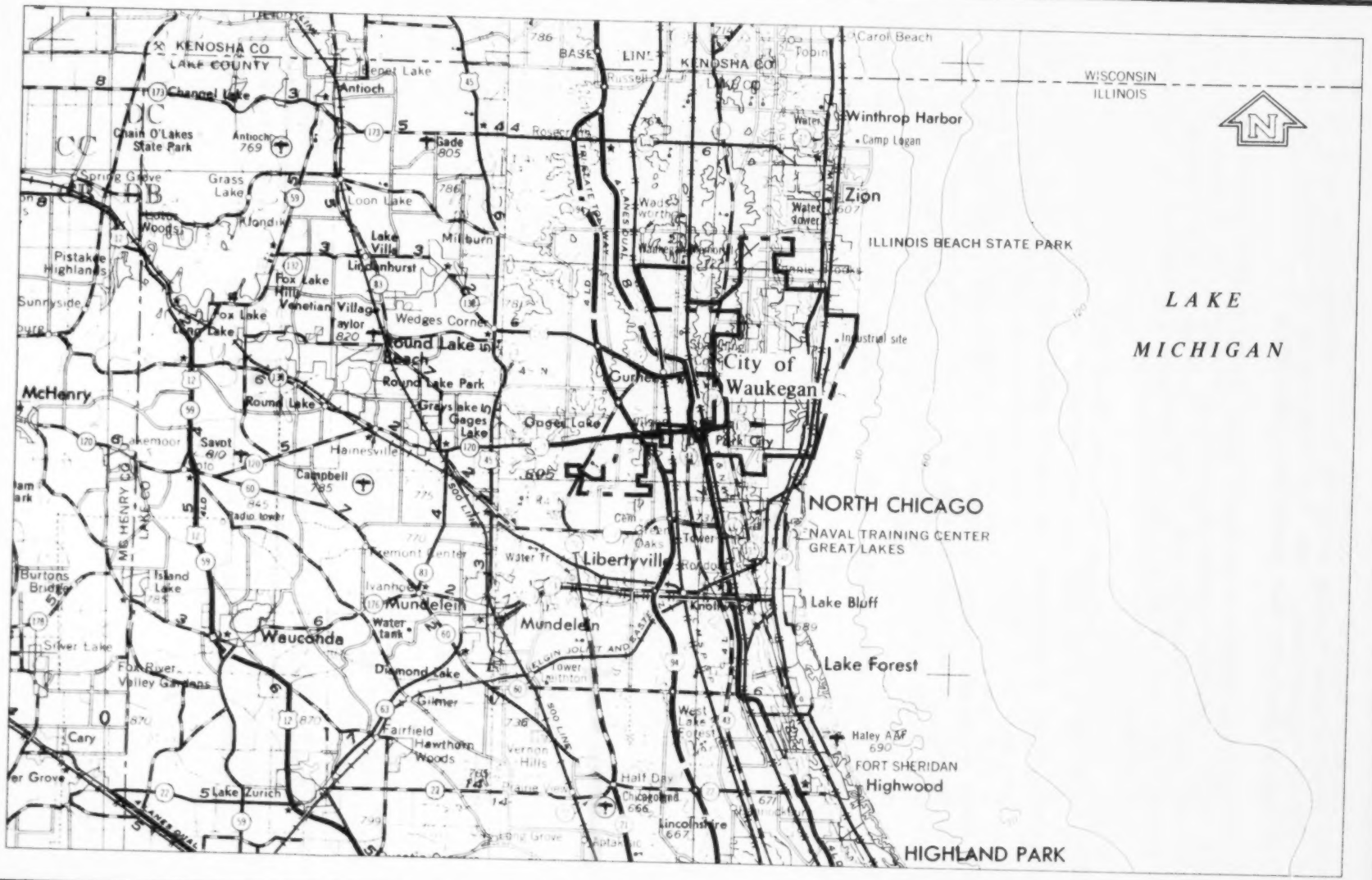

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF WAUKEGAN, IL
(LAKE CO.)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

corporate limits of the community. Similarly, only part of Bull Creek was found to cause flooding within the City of Waukegan, that being the stretch from approximately 930 feet downstream of DeWoody Avenue to approximately 530 feet upstream of Beach Road.

The entire reaches of the Skokie River and the North Branch Chicago River were studied by approximate methods. Bull Creek upstream of Lewis Avenue, the Wilson Avenue Tributary upstream of Wilson Avenue, and the upstream end of North Shore Ditch were also studied by approximate methods.

2.2 Community Description

The City of Waukegan is located in northeastern Illinois in the northeast portion of Lake County. The total land area contained within the city limits is 15.3 square miles. It borders Lake Michigan approximately 35 miles north of downtown Chicago between Zion on the north, Green Oaks and North Chicago on the south, and Gurnee and Park City on the west. According to U.S. Census Bureau figures the population has increased from 55,719 in 1960 to 65,259 in 1970 (Reference 1). The community is primarily residential with some heavy industry along the lakeshore south of the Illinois Beach State Park.

The climate is similar to that recorded at the Chicago Midway Airport (Reference 2). The average monthly temperature in January is 25 degrees Fahrenheit (F.) and in July is 74 degrees F. Extreme temperatures have ranged from a low of -19 degrees F. to a high of 104 degrees F. The average annual precipiation is 33.6 inches and the average annual snowfall is 41.1 inches. About 24 percent of the averge annual precipitation occurs in November, December, January, and February; 17 percent occurs in March and April; 32 percent in May, June and July, and 27 percent in August, September and October.

The topography of Waukegan is gently rolling, being greatly affected by Pleistocene age glaciers. The soil of much of the flood plain is composed of light colored loamy fine sand (Reference 3). The land surface elevations within the corporate limits range from about 585 feet at the Lake Michigan shore to 730 feet near the intersection of Sunset Avenue and Green Bay Road. The majority of the city is on a bluff about 50 feet high overlooking the lake. Vegetation is normally grass cover with a few trees, a situation typical of the Greater Chicago suburbs. Remaining agricultural plots are rapidly being developed for residential or commercial use, particularly in the southwest.

The Des Plaines River, which originates north of Waukegan, flows southeast along the city's western border for approximately 5.5 miles, and then to a confluence with the Kankakee River near Joliet, Illinois. The Suburban County Club Tributary to this river flows southwest through the

northwestern Waukegan area for about 5.2 miles. The 100-year flood plain of the Des Plaines River consists primarily of wetlands, and the flood plain of its Suburban Country Club Tributary is farm fields and sparse forest. There is the possibility that portions of the Midlane Golf Course near this tributary may be developed into a subdivision within the next few years.

Bull Creek flows eastward through the northeast portion of the city for about 3.2 miles. The Wilson Avenue Tributary to Bull Creek flows along Edgewood Road for about 1.3 miles to Bull Creek. Bull Creek's 100-year flood plain is primarily residential, while the flood plain of its tributary is primarily open land with some scattered residential developments.

The North Shore Ditch flows south for about 1.2 miles along the city's northeastern boundary. While the 100-year flood plain of the North Shore Ditch is presently open field, there is the possiblity for future residential development here.

The Waukegan River flows south through central Waukegan for about 7.6 miles (all except 2.3 miles is in an underground conduit). The Waukegan River's 100-year flood plain is residential with areas immediately adjacent to the streambed being trees and dense underbrush.

The Skokie River flows south through the southwestern portion of the city for about 1.0 mile. The drainage area is about 2.9 square miles, and the streambed has an average slope of about 7.3 feet per mile. The Skokie River's 100-year flood plain has residential and commercial development.

The North Branch Chicago River flows southeast through the far southwestern portion of Waukegan for about 1.6 miles. The drainage area is about 1.8 square miles, and the streambed has an average slope of about 25.0 feet per mile. The North Branch Chicago River flows through open fields and forest land where future development is not expected.

There is heavy industry along the southern half of Waukegan's Lake Michigan shoreline and along the northern half of the Illinois Beach State Park.

2.3 Principal Flood Problems

Many of Waukegan's flood problems can be attributed to the city's rapid growth since World War II. Poor soil drainage in the area combined with the development has caused increased runoff.

The present residential developments along Bull Creek and the Wilson Avenue Tributary to Bull Creek have flood problems due to overbank flooding from both channels. The areas near Greenwood and Western Avenues and at Glen Flora and North Avenues have storm sewer drainage problems.

A record of floods along the Des Plaines River in the Village of Gurnee, the only stream in the area with USGS gages is shown below.

HISTORIC FLOODS
DES PLAINES RIVER AT BELVIDERE ROAD

Water Year	Approximate Discharge Cubic Feet Per Second (cfs)	Approximate Recurrence Interval (years)
1960	4,000	90
1948	2,625	12
1962	2,500	10
1951	2,065	5
1950	1,750	3

2.4 Flood Protection Measures

There are no flood protection structures within or near the City of Waukegan. However, the city does have a flood plain development ordinance, based on the flood plain delineations in the USGS Hydrologic Investigations Atlases (References 4, 5, and 6).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The SCS completed a comprehensive flood plain management study of the Des Plaines River watershed as part of the Chicago Metropolitan Area River Basin Plan (References 7 and 8). Revised discharges for the 10-, 50-, 100-, and 500-year floods were computed at the following USGS gaging stations: on the Des Plaines River near Gurnee, Illinois (No. 05528000 with 29 years of record); and on the Des Plaines River at Russell, Illinois (No. 05527800 with 16 years of record) using a log-Pearson Type III method (Reference 9). The discharges at locations other than gage sites were interpolated based on drainage area. The SCS also studied the Suburban Country Club Tributary. These discharges were determined using the SCS watershed model TR-20 (Reference 10). It is an advanced hydrologic model which accurately simulates the historic flood stage and discharge hydrographs. The estimates of flood discharge resulting from this study are the most current.

The hydrologic analyses for Waukegan River, North Shore Ditch, Bull Creek, and the Wilson Avenue Tributary to Bull Creek followed the State Standard Method. Discharges for the 2- and 100-year floods were computed using regional equations for northeastern Illinois (Reference 11). These discharges were plotted on log-normal probability paper. The 10-, 50- and 500-year flood discharges were estimated by straight line interpolation and extrapolation. The 500-year flood discharge is less reliable than the others, because the period of record for the discharge gages used to develop the regional equations is only about 30 years.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross section data for the Des Plaines River were taken from an SCS study (Reference 7) and cross section data for Suburban Country Club Tributary were taken from the Flood Insurance Study for Lake County (Reference 12). Cross section data for the remaining streams studied in detail were determined through field survey.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n" values) for these computations were assigned on the basis of field inspection and previous analysis by the SCS (References 7 and 8). The range of "n" values for the streams in Waukegan are as follows:

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DES PLAINES RIVER					
River Road at St. Francis Boys Camp	237.50	2,640	3,810	4,300	5,410
SUBURBAN COUNTRY CLUB TRIBUTARY					
Delany Road	4.36	233	386	455	643
Chicago and North Western railroad	2.84	199	331	390	545
BULL CREEK					
Chicago and North Western railroad	6.06	996	1,516	1,760	2,385
Talmadge Avenue	2.40	520	790	930	1,240
Wilson Avenue	1.75	270	413	479	647
Leland Avenue and Lewis Road	0.69	207	302	381	461
NORTH SHORE DITCH					
Chicago and North Western railroad	0.80	186	281	327	445
Rice Street	0.42	143	217	251	339
WAUKEGAN RIVER					
Glen Flora Avenue	3.40	527	809	927	1,267
Clearview Avenue	2.72	458	697	807	1,107
Sunset Avenue	1.68	330	500	580	788

Roughness Coefficients (Manning's "n" Values)

Stream	Channel	Overbank
Des Plaines River	0.035 - 0.060	0.070 - 0.100
Suburban Country Club Tributary	0.075	0.075 - 0.085
Bull Creek	0.016 - 0.040	0.030 - 0.060
Wilson Avenue Tributary	0.030 - 0.040	0.030 - 0.050
Waukegan River	0.040 - 0.045	0.035 - 0.040
North Shore Ditch	0.040 - 0.055	0.040 - 0.050

Starting water-surface elevations for the Des Plaines River were taken from a previous study by Harza. In this 1977 study, Harza recomputed the flood profiles for the Des Plaines River using the SCS cross section and bridge data and the discharges determined by the USGS. This study was used by the State of Illinois, Division of Water Resources to prepare regulatory flood profiles, regulatory flood plains, and regulatory floodways (Reference 13). The starting water-surface elevations for the Suburban Country Club Tributary were the two-year flood elevations on the Des Plaines River at the confluence. This was done to assure that the floodway near the mouth of the Suburban Country Club Tributary would reflect only conditions on the tributary and not backwater effects from the Des Plaines River. The starting water-surface elevations for each flood for the Waukegan River at Glen Flora Road were determined by using a number of trial elevations about 0.5 mile downstream. These trial elevations produced profiles which converged at Glen Flora Road. The North Shore Ditch, Bull Creek, and the Wilson Avenue Tributary had their starting water-surface elevations computed using the slope-area method.

Water-surface profiles were computed using the SCS WSP-2 program for the detailed study streams (Reference 14). Mathematical relationships used in the program include the standard step-backwater procedure which estimates total energy at each cross section and accounts for friction losses between sections using Manning's formula. The program requires discharge, cross section geometry, bridge geometry, starting water-surface elevation, and roughness data to simulate flood flow conditions. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The U.S. Army Corps of Engineers (COE) analyzed the shoreline characteristics of Lake Michigan (Reference 15). The stormwater elevation-frequency relationship for the Waukegan shoreline was obtained from this report. This relationship is listed in Table 2.

TABLE 2 - SUMMARY OF ELEVATIONS

LOCATION	ELEVATIONS (FEET) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAKE MICHIGAN				
At Waukegan	582.8	583.7	584.0	584.6

The elevations listed in Table 2 are storm surge elevations due to tidal and wind set up only and do not include the contributions from wave action effect such as the wave crest height and wave runup. This additional hazard due to wave action should be considered in the planning of future development. A wave runup of about 2.5 feet for the 100-year flood is being considered by the Illinois DWR for its Lake Michigan open-coast flood plain regulation.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of two feet (Reference 16), and topographic maps at a scale of 1:24000, with a contour interval of 10 feet (Reference 17). Flood boundaries for the stream reaches studied by approximate methods were obtained from the Hydrologic Investigation Atlas Maps for the Waukegan, Zion, and Wadsworth Quadrangles published by the USGS (References 4, 5, and 6). Additional areas of approximate flooding were taken from the Flood Hazard Boundary Map (Reference 18).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Illinois though, under Revised Statutes, Section 65f, Chapter 19 as amended 1973 (Reference 19), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Illinois Division of Water Resources, a floodway having no more than a 0.1-foot surcharge has been delineated for this study.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. These floodways were determined through the use of the HUD-15 computer program (Reference 20). The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3). Portions of the floodways for the detailed study streams lie outside of the corporate limits.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
DES PLAINES RIVER								
A	272,420	760[3]	3523	1.2	660.5	660.5	660.6	0.1
WAUKEGAN RIVER								
A	13,730	42	289	3.2	650.6	650.6	650.7	0.1
B	16,130	232	540	1.7	651.9	651.9	652.0	0.1
C	16,396	38	165	4.9	652.7	652.7	652.8	0.1
D	17,630	58	243	3.3	654.1	654.1	654.2	0.1
E	18,445	67	313	1.9	654.3	654.3	654.4	0.1
F	18,992	179	615	0.9	654.5	654.5	654.6	0.1
BULL CREEK								
A	21,706	31	85	5.5	654.6	654.6	654.7	0.1
B	22,476	16	78	5.6	658.8	658.8	658.9	0.1
SUBURBAN COUNTRY CLUB TRIBUTARY								
A	6635	1900	2638	0.2	665.3	662.6[6]	662.7	0.1
B	8235	1875/1390[4]	3297	0.1	665.3	662.7[6]	662.8	0.1
C	12,985	560	617	0.6	669.4	669.4	669.5	0.1
NORTH SHORE DITCH								
A	100[2]	475	670	0.5	648.4	648.4	648.5	0.1
B	1250[2]	268	249	1.3	650.0	650.0	650.1	0.1
C	2700[2]	1004[5]	899	0.3	650.7	650.7	650.8	0.1
D	3800[2]	65	112	2.3	653.7	653.7	653.8	0.1

[1]FEET ABOVE MOUTH
[2]FEET ABOVE LIMIT OF DETAILED STUDY 150 FEET UPSTREAM OF WESTERN AVENUE
[3]THIS WIDTH IS BEYOND CORPORATE LIMITS
[4]TOTAL WIDTH / WIDTH WITHIN CORPORATE LIMITS
[5]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS
[6]ELEVATIONS WITHOUT CONSIDERNG BACKWATER EFFECT FROM DES PLAINES RIVER

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF WAUKEGAN, IL
(LAKE CO.)

FLOODWAY DATA

DES PLAINES RIVER - WAUKEGAN RIVER - BULL CREEK - SUBURBAN COUNTRY CLUB TRIBUTARY - NORTH SHORE DITCH

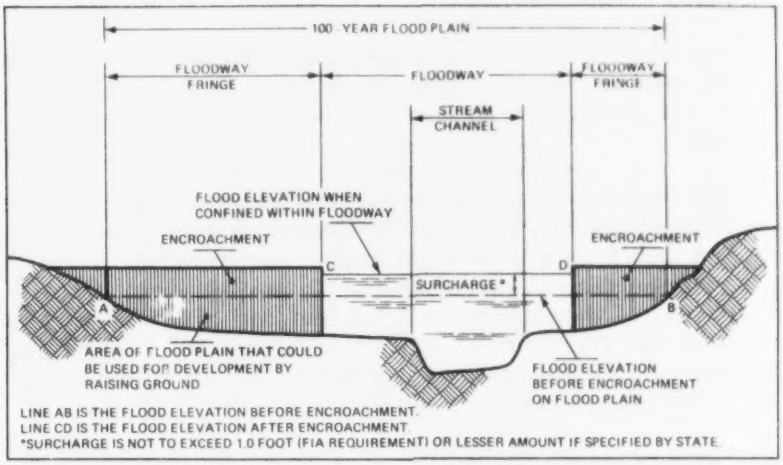
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Waukegan.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Waukegan are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Waukegan was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A1-A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
DES PLAINES RIVER							
REACH 1	0009	–2.5	–0.3	0.7	025	A5	VARIES–SEE MAP
WAUKEGAN RIVER							
REACH 1	0004	–1.3	–0.3	1.0	015	A3	VARIES–SEE MAP
BULL CREEK							
REACH 1	0002	–1.0	–0.3	0.6	010	A2	VARIES–SEE MAP
SUBURBAN COUNTRY CLUB TRIBUTARY							
BACKWATER REACH[4]	0001,0003	–2.0	–0.5	0.8	020	A4	VARIES–SEE MAP
REACH 1	0001,0003	–0.6	–0.2	0.3	005	A1	VARIES–SEE MAP
NORTH SHORE DITCH							
REACH 1	0002,0004	–0.3	–0.1	0.2	005	A1	VARIES–SEE MAP
LAKE MICHIGAN							
REACH 1	0005,0008,0011	–1.2	–0.3	0.6	010	A2	584

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT
[4] DATA FOR THIS REACH TAKEN FROM VILLAGE OF GURNEE, ILLINOIS FIS

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF WAUKEGAN, IL
(LAKE CO.)

FLOOD INSURANCE ZONE DATA

DES PLAINES RIVER - WAUKEGAN RIVER - BULL CREEK - SUBURBAN COUNTRY CLUB TRIBUTARY - NORTH SHORE DITCH - LAKE MICHIGAN

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Waukegan is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The Des Plaines River was included in a flood water management plan for the Des Plaines River watershed prepared by the Des Plaines River Watershed Steering Committee with assistance by the SCS (Reference 7). The committee also published flood plain maps and flood profiles for the Des Plaines River (Reference 8). The profiles for the Des Plaines River were recomputed by Harza and used by the State of Illinois for Flood Plain Regulations (Reference 13). These recomputed profiles were used in this study. The Suburban Country Club Tributary was studied for the Lake County Flood Insurance Study (Reference 12) and incorporated in this report. The Report on Great Lakes-Open Coast Flood Levels by the Detroit District COE, was used to define flood hazard areas along the Lake Michigan Coast in Waukegan (Reference 15). This study is in agreement with the Flood Insurance Studies for the unincorporated areas of Lake County (Reference 12), and the adjacent communities of Gurnee, Green Oaks, and Park City (References 21, 22, and 23). The Flood Insurance Study for North Chicago (Reference 24) will be coordinated with this study.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 18). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

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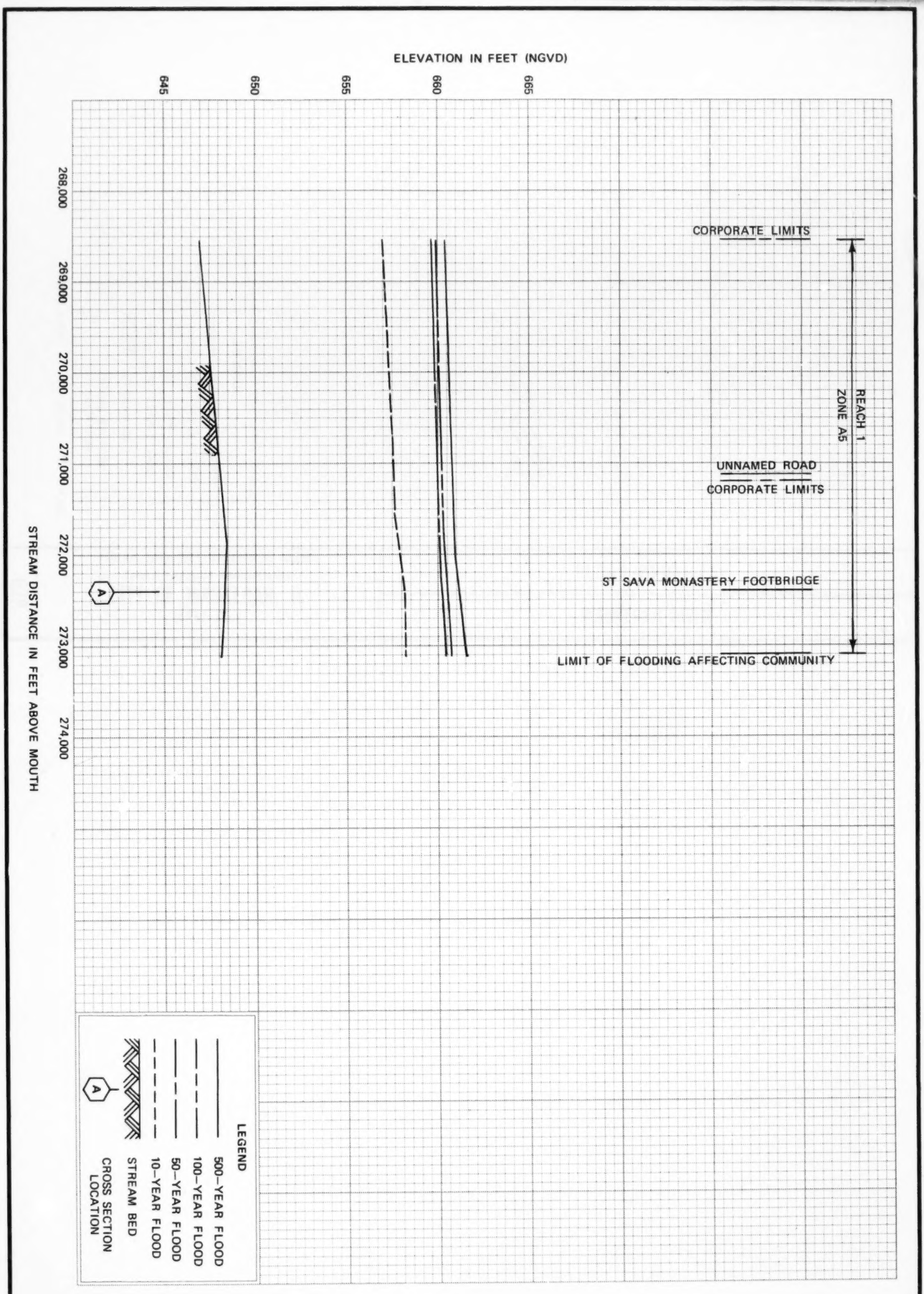

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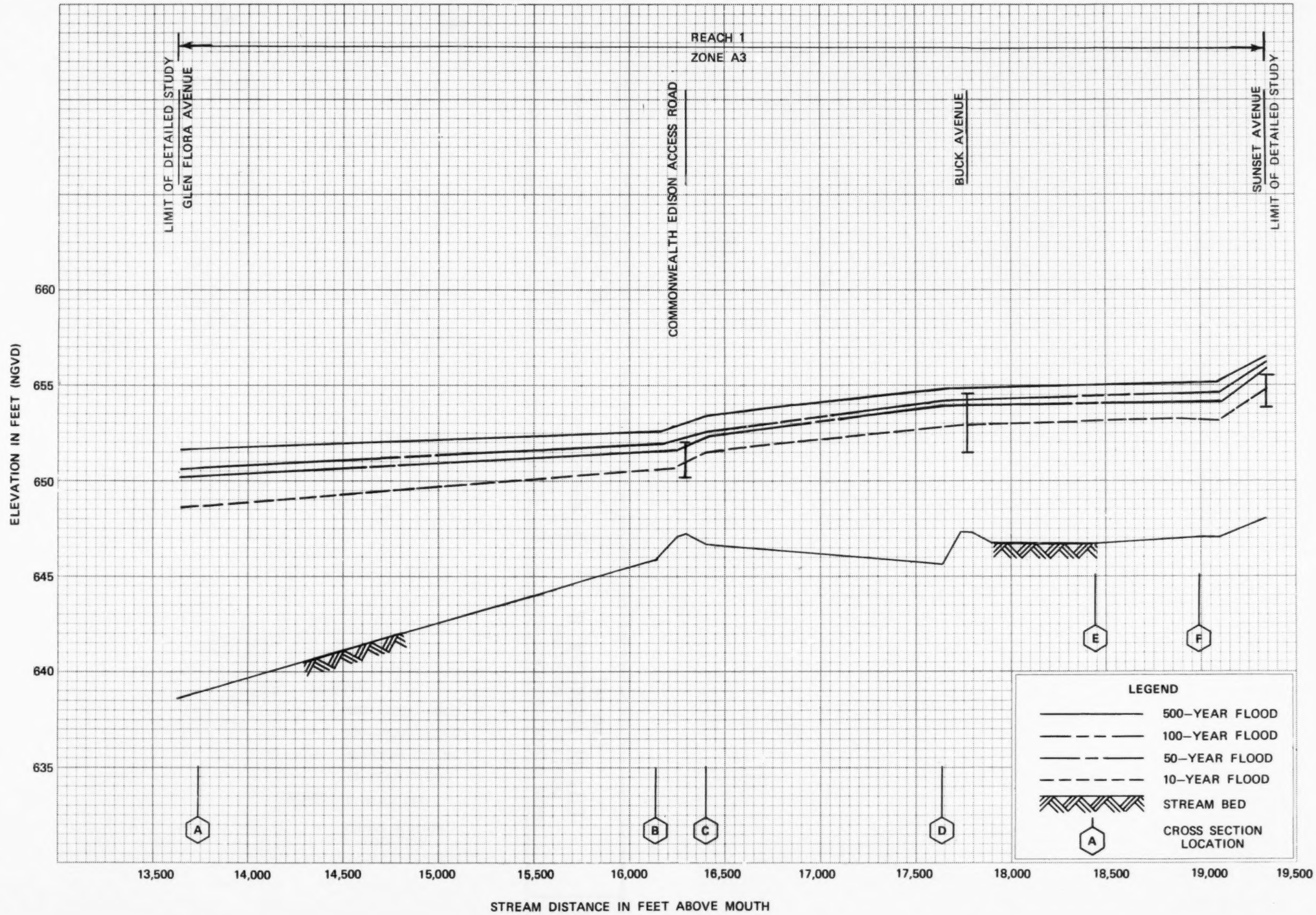


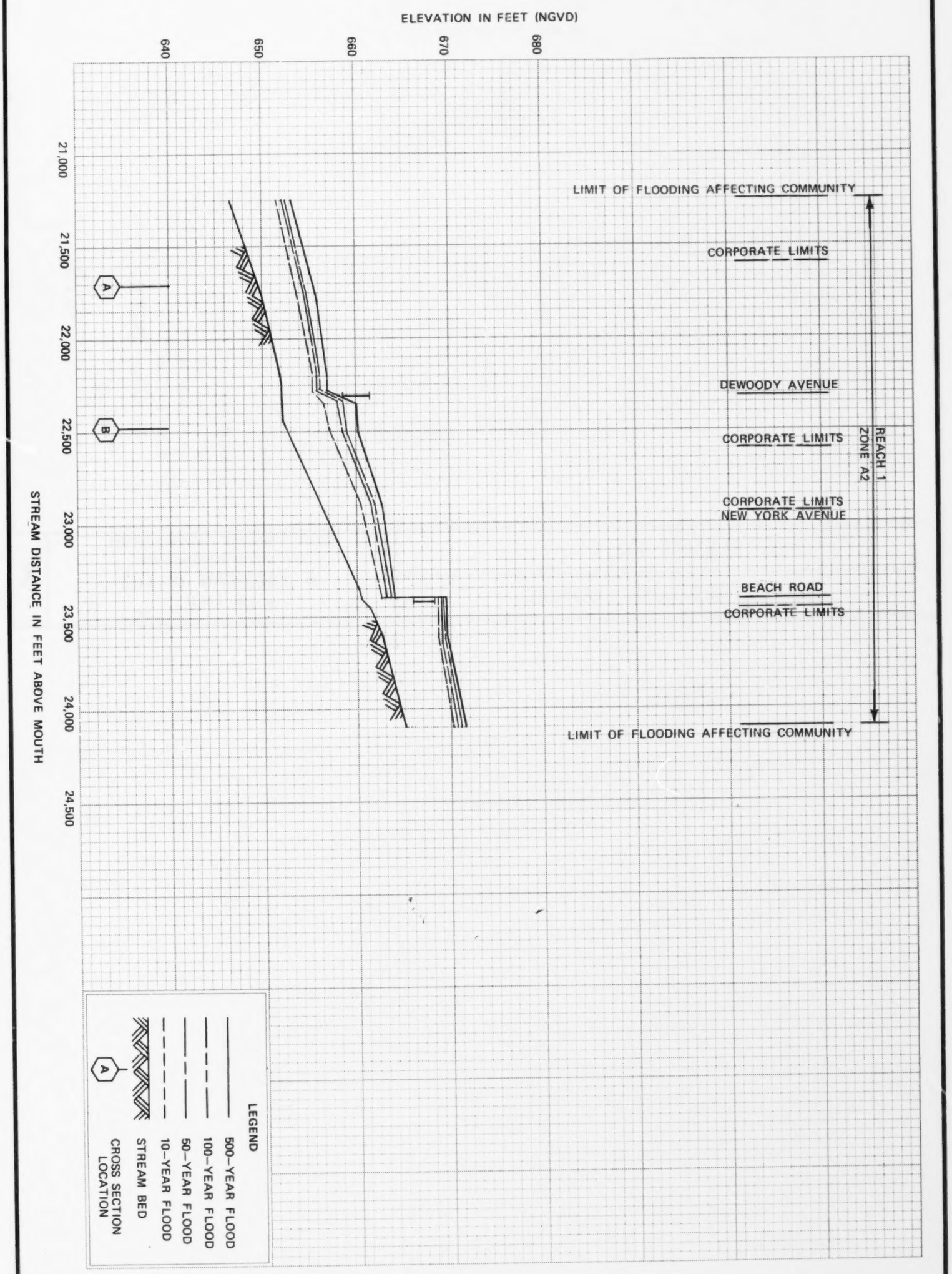
FLOOD PROFILES

WAUKEGAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF WAUKEGAN, IL
(LAKE CO.)

02P



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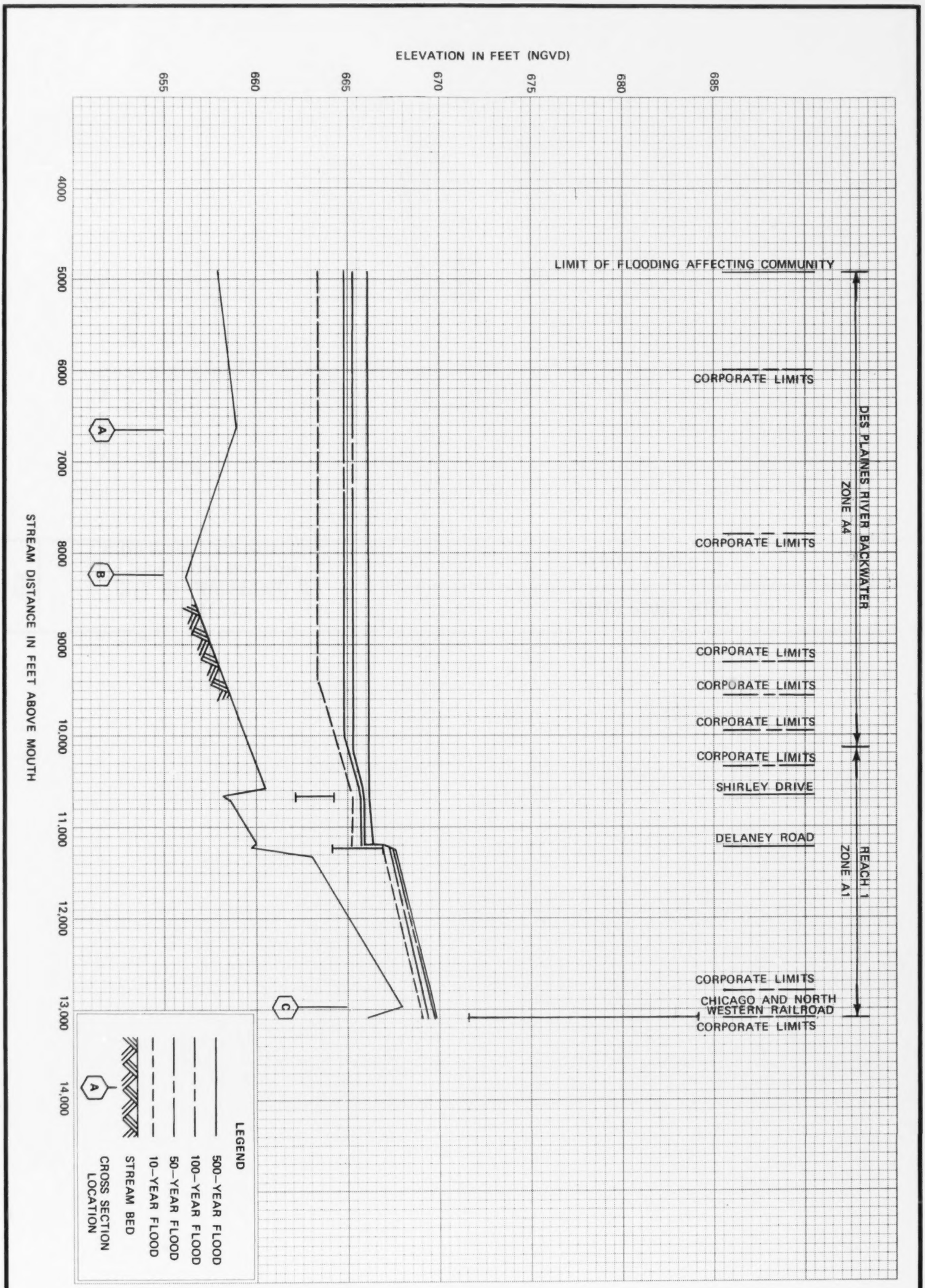
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF WAUKEGAN, IL
(LAKE CO.)

FLOOD PROFILES

BULL CREEK



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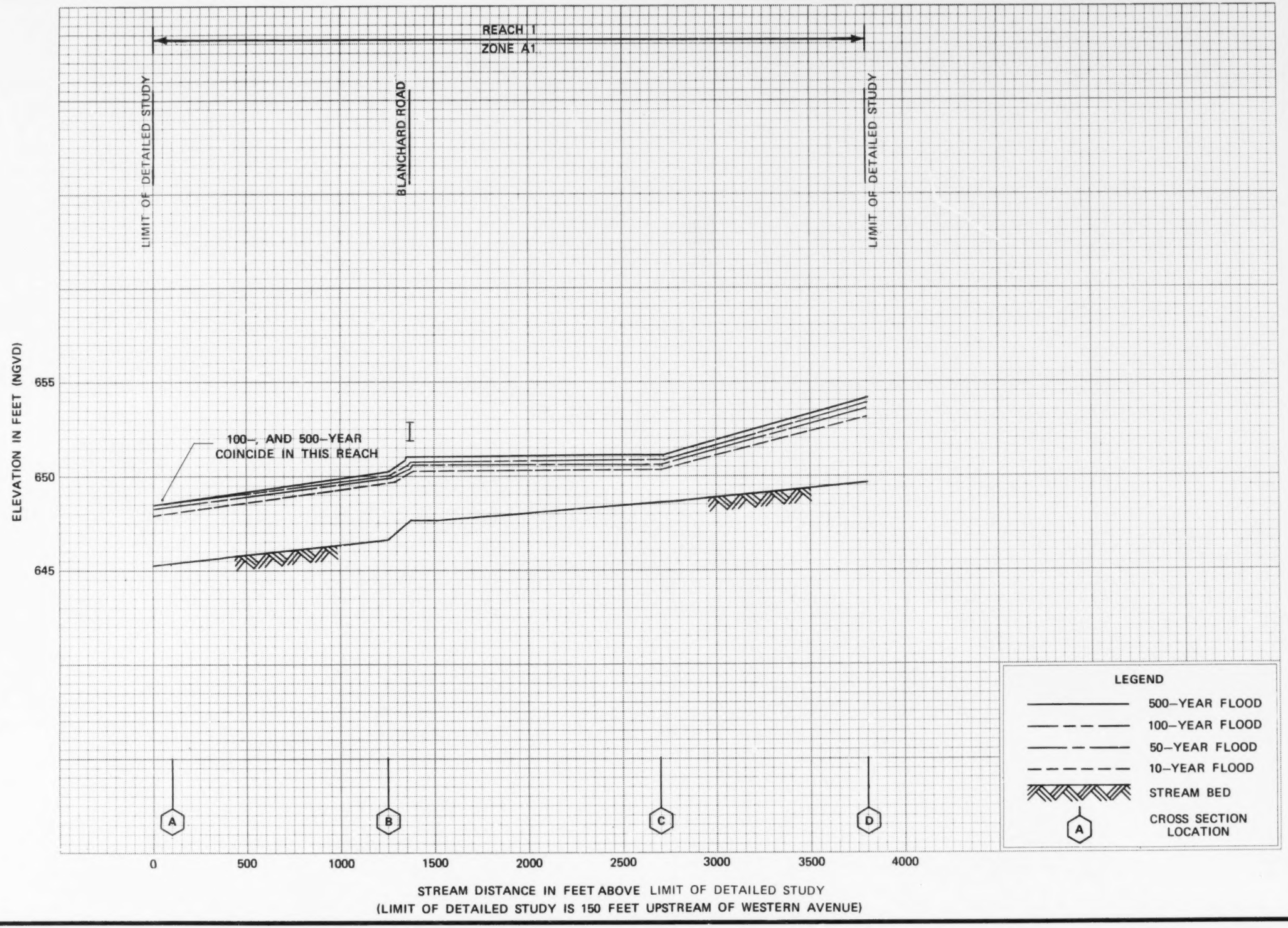
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF WAUKEGAN, IL
(LAKE CO.)

FLOOD PROFILES

SUBURBAN COUNTRY CLUB TRIBUTARY



FLOOD PROFILES

NORTH SHORE DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF WAUKEGAN, IL
(LAKE CO.)

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